# CTN Test Report
## 92-007
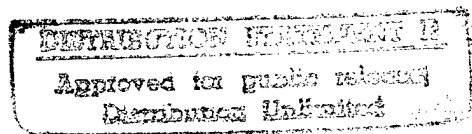
**CALS TEST NETWORK**

AITI/1171
UCRL-ID-110709

# CALS Test Network
# Sacramento Air Logistics Center
# CALS/EDI Transfer Test
# Number 2

# Quick Short Test Report

**3 March 1992**

**19960822 145**

DTIC QUALITY INSPECTED 3

# CTN Test Report
## 92-007

**CALS TEST NETWORK**

AITI/1171
UCRL-ID-110709

# CALS Test Network
# Sacramento Air Logistics Center
# CALS/EDI Transfer Test
# Number 2

# Quick Short Test Report

Prepared by
Lawrence Livermore National Laboratory.

LLNL Contacts
Nick Mitschkowetz
510/422-0582

Don Vickers
510/422-4231

CTN Contact
Mel Lammers
513/257-3085

**3 March 1992**

DTIC QUALITY INSPECTED 3

DISCLAIMERS

# Contents

THIS PAGE IS INTENTIONALLY LEFT BLANK.

## Abstract

This report details the results from a test conducted among  the Air Force
CALS Test Bed, Wright-Patterson Air Force Base, Ohio,
the Lawrence Livermore National Laboratory EC/EDI (Electronic Commerce Through Electronic
Data Interchange) Project, and the Sacramento Air Logistics Center (SM-ALC), McClellan AFB,
CA. The test required CALS data (MIL-R-28002A Raster) to be sent in an EDI (Electronic Data
Interchange) envelope over a commercial VAN (Value Added Network).

CALS Test Network Sacramento Air Logistics Center CALS/EDI Data Transfer Test Number 2
Quick Short Test Report.

## Executive Summary

The Department of Defense (DoD) Computer-aided Acquisition and Logistic Support (CALS) Test Network (CTN) conducts tests of the military standard for the Automated Interchange of Technical Information, MIL-STD-1840A, and its companion suite of military standards. The CTN is a DoD-sponsored confederation of voluntary participants from industry and government, managed by the Air Force Materiel Command at Wright-Patterson Air Force Base (WPAFB). The Lawrence Livermore National Laboratory (LLNL) is a technical lead within the CTN Office.

The test, conducted from October 7th through November 25th, dealt with transmitting CALS data over a commercial network in an EDI (Electronic Data Interchange) envelope, and the results demonstrate that this can currently be done. An important result of this test was the indication that binary based X.12-841 transactions can be successfully transferred on network environments (such as X.400 and TCP/IP), providing a useful tool to the overall CALS process. Test participants included Lawrence Livermore National Laboratory, TRW, AT&T, Supply Tech, SM-ALC, and the CAM Software Research Center (CSRC).

# 1 Introduction

## 1.1 Background

The Department of Defense (DoD) Computer-aided Acquisition and Logistic Support (CALS) Test Network (CTN) is conducting tests of the military standard for the Automated Interchange of Technical Information, MIL-STD-1840A, and its companion suite of military specifications. The CTN is a DoD-sponsored confederation of voluntary participants from industry and government managed by the Air Force Materiel Command. The Lawrence Livermore National Laboratory (LLNL) is the technical lead of the CTN Office.

The primary objective of the CTN is to evaluate the effectiveness of the CALS standards for technical data interchange and to demonstrate the technical capabilities and operational suitability of those Standards. One approach to achieving this objective is the demonstration of technical interchanges in preparation for major CALS-related conferences. Such interchanges not only demonstrate the functional status of the standards, promoting confidence in their use, they also provide the CTN with additional opportunities to evaluate the applicability of the standards.

The demonstrations provide, not only an excellent testing environment, but also a tutorial opportunity for those learning about the standards. Attendees of the demonstration wrap-up (contractors, subcontractors, military, etc.) learn that the Standards work, learn that they work relatively easily, learn how they can be used, and identify points of contact for future involvement. Vendors are able to test their latest implementations (interpretations) of the Standards and to collaborate with the CTN technical staff. The CTN technical staff is able to broaden their testing base by gathering up-to-date information on current vendor interpretations of the Standards. In addition, they receive immediate feedback on their testing procedures, test documents, and tools.

Though interchanges for conferences are primarily used for demonstrating the status and functionality of the Standards, the CTN considers each interchange, formal or informal, to be a test. The results of the tests are reported in Quick Short Test Reports (QSTRs) that briefly summarize the standard(s) tested, the participants, the hardware and software used, the nature of the test, and the results.

## 1.2 Electronic Commerce Through Electronic Data Interchange

Another DoD-sponsored initiative is the Electronic Commerce (EC) Through Electronic Data Interchange (EDI) Program. The Deputy Secretary of Defense has called for the maximum use of EDI for the paperless processing of all business-related transactions. Operating as the lead engineering agency for the EC/EDI Project, LLNL conducts the research necessary for the advanced development of this major DoD initiative.

The EC/EDI Program plans to move beyond the traditional EDI technologies into complete electronic commerce, "end-to-end paperless commerce." Electronic commerce will include traditional EDI, electronic mail, transparently secure database access, system-wide data protection, and more. For example, the entire acquisition process can be conducted under EC. Some of these steps might be: requisitioning the item, issuing a Request for Quote, receiving bids, issuing an Engineering Change Order, etc. For this process, being able to deliver CALS data (an engineering drawing, for example) in an EDI transaction set will be imperative to support the "end-to-end" paperless commerce concept. There has been some concern, however, that CALS data sets are too large and of a format such that EDI cannot support the data transmission. Also, there are concerns that existing data networks cannot provide sufficient bandwidth to support the

transmission of the EDI transaction sets. The EC/EDI Project wants to show that these issues are surmountable.

The previous test demonstrated that CALS data could be wrapped in an EDI format, transferred from LLNL through a commercial VAN, and returned to LLNL in tact. However, technical issues relating to the applications software precluded the actual implementation of an 841 binary data set. The current test builds on that experience.

## 1.3 Purpose

The unique situation of having lead technical organizations for both CALS and EC/EDI in one location makes it convenient for LLNL to conduct tests which use CALS information in EDI transactions. Indeed, a previous test conducted in concert with Sacramento Air Logistics Center (SM-ALC) provided useful insights which have led to this Follow-on Test. (See CTN Report 90-044 for details on the earlier test.)

The previous test established that:

- Interchange of CALS technical information through EDI is "do-able".
- Binary files such as CALS raster data can be transmitted in an EDI envelope.
- CALS and EDI data can be transmitted via ISDN circuits.
- Existing data networks can provide sufficient bandwidth for CALS and EDI data.

This Follow-on Test will go several steps further by:

- Testing with actual bid set data.
- Testing various image sizes.
- Testing EDI Transaction Set 841 in its final form.
- Testing procedures for evaluating stages of the upcoming PCIP
  (Procurement, Contracting, and Industrial Preparedness) pilot project.

The EDI 841 Transaction Set is now fully implemented and an integral part of commercially available EDI products. The current test focuses on the need to demonstrate an end-to-end CALS/EDI binary data interchange, using current bid-set data generated by SM-ALC.

The test scenario applies the X.12 EDI standards, X.400 routing standard, and the CALS MIL-R-28002A Type II raster data standard to demonstrate an end-to-end technical data interchange using commercially available technology.

An added benefit of this test would be to demonstrate the possible applications of digital data interchanges for the SM-ALC participants (Engineering, Engineering Data Computer-Assisted Retrieval System (EDCARS), and procurement) while allowing LLNL CALS and EDI organizations to participate in real world applications.

# 2 Test Parameters

**Test Plan Number:** CTN Number XXX

**Dates of Testing:**

| | | |
|---|---|---|
| Phase I | October 7 | - October 29 |
| Phase 2 | October 30 | - November 8 |
| Phase 3 | November 9 | - November 25 |

**Evaluator(s)**

Nick Mitschkowetz, Raster Lead Analyst
Lisa J. Nafziger, CGM Lead Analyst
Donald Vickers, CTNO Test Bed Manager
Automated Interchange of Technical Information Project
Lawrence Livermore National Laboratory
P.O. Box 808, L-542
Livermore, CA 94551
(510) 422-0582    (Mitschkowetz)
(510) 423-7355    (Nafziger)
(510) 422-4231    (Vickers)

Bob Frank, EC/EDI Project Leader
Tom Root, Technical Lead PCIP Project
EC Through EDI Project
Lawrence Livermore National Laboratory
P.O. Box 808, L-542
Livermore, CA 94551
(510) 422-0070    (Frank)
(510) 294-4185    (Root)

**Test Participants:**

Dell K. Allen, Director
CAM Software Research Center
265 Crabtree Technology Building
Brigham Young University
Provo, UT 84602
(801) 378-3895

Dee Smith, Chief, Aircraft Contracting Division
Sacramento Air Logistics Center
SMALC/LAK
McClellan Air Force Base, CA 95662
(916) 643-0683

Bud Orlando
TRW
One Space Park, Mail Stop E1-4029
Redondo Beach, CA 90278
(213) 812-4997

**Data Description:**

EDCARS Raster Data 2 sets containing:
9 MIL-R-28002A Raster images

**Data Source
System/Platform:**     <u>LLNL  Platform:</u>

DOS PC 386, MS-DOS Operating System
DDN Connection
AT&T VAN  Connection

<u>CAM Software Research Center Platform:</u>

MicroVAX II, VMS 5.0 Operating System
IBM PS/2 model 80, MS-DOS Operating System
MAC IIcx, MAC OS

<u>Sacramento Air Logistics Center Platform:</u>

AT&T 3B2/600G Computer
UNIX System V, Version 3.2.2 Operating System
DDN Connection

<u>TRW  Platform:</u>

DOS PC 386, MS-DOS Operating System
AT&T VAN  Connection

**Evaluation Tools
Used:**     MIL-R-28002A (Raster) Analysis

CTN CALSTB.350 software tools on a Sun Microsystem 3/60

ANSI (American National Standards Institute)
EDI X.12 Transaction Set 841 (CALS through EDI) Analysis

Supplytech Software, STX12

# 3   Interchange Scenario

Phase I

Actual bid set engineering data will be transferred from SM-ALC's EDCARS repository to their AT&T/3B2 platform. Software to assist with the EDI packaging will be placed onto the AT&T/3B2. Using this software, the CALS data will be placed into the 841 Transaction Set.

Phase II

The CALS data, within an 841 Transaction Set, will be transferred to Lawrence Livermore National Laboratory (LLNL) via an Internet (DDN) connection, where it will be received and analyzed.

Phase III

The CALS Data will be wrapped in an X.12-841 transaction, packaged as an X.400 message, and transferred to the CAM Software Research Center at Brigham Young University and TRW in Redondo Beach via a VAN (Value Added Network) to test CALS/EDI transmission over VAN lines. The recipients will FAX hard-copies of the images and send binary copies of the images received back to LLNL for evaluation. Test results and recommendations will be published as a standard CALS Test Network Quick Short Test Report (QSTR).

This test focused on the ANSI X.12 841 Specification Technical Documentation Transaction Set. A full bid set uses multiple EDI Transaction Sets, notably 840 (Request for Quote), 842 (Response to Request for Quote), 850 (Response to Purchase Order), and 855 (Purchase Order Acknowledgment). Non-technical acquisition transactions are scheduled for testing at Wright-Patterson Air Force Base.

Using a program written at LLNL, SM-ALC packaged their CALS information into the proper EDI Transaction Set 841, and LLNL used FTP (File Transfer Protocol) to pull the transaction set over the Internet to the Livermore hub. The previous CALS/EDI transfer test (in 1990) used a similar program to place CALS data into an EDI transaction. However, at that time the ANSI X.12 standard was not in final form, resulting in an 841 Transaction Set which deviated from the final specification (published in December 1990). The standard now states that the BIN element should be coded as:

```
BIN*number_of_octets*Binary_data_starts_here
```

Tom Root at LLNL made the necessary adjustments so that the current program follows the ANSI X.12 requirements. The test scenario had intended to place CALS data into an X.12-841 Transaction Set on the source node, an AT&T/3B2 computer at SM-ALC, before sending the data to LLNL. However, Internet connection problems, beyond the control of SM-ALC or LLNL, impeded access and thwarted transmission efforts, significantly delaying the test. Analysis of the data transmissions between the AT&T/3B2 and LLNL indicated that the CALS data was being truncated or corrupted.

It became clear that an alternate network route would be required. After many attempts, through various network connections, LLNL was able to receive valid CALS files from an SM-ALC network node. To expedite the process, EDI conversion would be undertaken on the LLNL hub, which would act as the data source.

Application of the binary capabilities of the X.12-841 in conjunction with the X.400 routing architecture is an important capability in the CALS/EDI digital data interchange scenario. The test demonstrated the synergy of these two standards on the AT&T GMS VAN which connected the end users. Given the configurational flexibility of messaging networks employing the X.400 standard, a future testing might include multiple X.400 Vans (or data Hubs) in the topology of the test scenario.

Through a connection to the AT&T GMS VAN, LLNL sent the data to TRW in Redondo Beach, which represents a large vendor in the procurement process. LLNL intended to send the same data to the CAM Software Research Center (CSRC) at Brigham Young University which represents a small business access hub, another strategy for commercial participation in the test. However, time and resource constraints precluded the implementation of a VAN connection to that site. The small business link is a significant component of the CALS/EDI procurement scenario and is the target for upcoming efforts.

LLNL connected to the VAN via modem, addressing the files to the TRW mailbox. TRW retrieved the files from their mailbox using the same STX.12 software. After extracting the CALS data, TRW converted the CALS images, for display and printing, using HIJAAK software and PCTPAINT software on a personal computer. TRW faxed copies of the images to LLNL as they were being received to indicate the tests progress. Later, TRW sent the binary CALS files, retrieved from the EDI transmission, to LLNL on MS-DOS floppy disks for evaluation.

# 4    1840A Analysis

The data sets retrieved from the EDCARS optical storage were transferred to MIL-STD-1840A magnetic tape and then read onto a Digital Equipment Corporation (DEC) computer with a 9-track magnetic tape peripheral device.

Currently CALS standards only specifies magnetic tape media as an interchange mechanism, but this does not preclude the use of other mechanisms, as was demonstrated in the test. The absence of a tape transfer between the source and destination nodes obviates the need for media structure analysis.

However, the CALS digital data interchange strategy does require the use of Declaration files and specific file name structures to assist with data identification and relationship issues. Having no previous CALS data handling experience, the SM-ALC systems operator mounted the EDCARS produced CALS tape as a "foreign" volume. This procedure circumvented the ANSI X3.27 tape file structure and simply dumped the contents of the CALS tape onto a computer disk, obscuring the CALS file naming conventions. The absence of the CALS file naming conventions made reassembling the two data sets at LLNL considerably more difficult.

Digital data, as opposed to its conventional equivalent (in this case microfilm aperture cards and paper drawings), is somewhat more difficult to identify. Where conventional engineering records can be relied upon to provide color, edge-cuts, document shape, and any number of other tangible attributes to aid in their identification, digital data files are limited to attributes such as a file-names and directory structures.

# 5 MIL-R-28002 (Raster) Analysis

## 5.1 Data Description

The Aircraft Contracting Division at SM-ALC identified image data sets required for an inventory control acquisition transaction. These data sets were the logical equivalent of microfilm aperture cards that normally accompany acquisition transactions which include technical data.

The image data was solicited from the Air Force Engineering Data Computer-Assisted Retrieval System (EDCARS), where raster images are routinely retrieved from optical storage media.

The EDCARS system presently converts digital images to conventional aperture cards for distribution. Recent modifications to EDCARS allow the image data to be delivered in a digital form as articulated by the CALS standards (MIL-STD-1840A and MIL-R-28002A).

Two sets of "digital aperture cards" were transferred to LLNL as part of the initial test process. Each file in a set represented the logical equivalent of one aperture card image. An aperture card may contain the photographic image of one or more sheets of paper, in various sizes, containing text and/or graphic information pertaining to the acquisition transaction.

The image files in each data set consisted of 9 MIL-R-28002 raster images scanned from the original documents at a resolution of 200 lines per inch.

Each of the first eight images in both data sets displayed multiple 8.5" X 11" sheets comprising a 30-page technical document. Image nine in both sets displayed a separate single sheet of paper.

The image content and quality were typical of the digital data experienced by the CTN while testing the CALS data capabilities of the three DoD engineering data repositories: DSREDS (Digital Storage and Retrieval Engineering Data System), EDCARS and EDMICS (Engineering Data Management Information and Control System).

The image sizes ranged from 8.48" X 11.14" to 20.88" X 26.25", while the average file size was just under 100KB. The average compression ratio achieved by the CCITT (Comite Consultatif Internationale de Telegraphique et Telephonique, or International Consultative Committee on Telegraphy and Telephony) Group-4 algorithm was 26:1.

## 5.2 Network Anomalies

The image data placed onto the DEC via an 1840A magnetic tape was transferred over the LAN from the DEC machine to an AT&T/3B2 for encapsulation in an X.12 841 transaction envelope and subsequent Internet/DDN transfer to LLNL. The X.12 encoding strategy combined all nine image files into one set of digital aperture cards, to accommodate the transfer of data across the Internet/DDN. Two separate sets of nine images were transferred in two separate X.12 Transaction Sets.

Upon receipt of the data interchange, LLNL parsed the X.12 envelopes and then retrieved the individual image files. Nine image files from each Transaction Set were separately analyzed using the CTN CALSTB.350 software tools on a Sun Microsystem 3/60.

Analysis indicated that almost all the image files in both data sets contained anomalies. The anomalies were characterized as fatal because the images were either prematurely truncated or totally aberrated at a certain point. The cause of the anomalies was determined to be the network route between LLNL and SM-ALC.

Successfully retrieving all the image files in both data sets from the SM-ALC through individual File Transfer Protocol (FTP) binary transfers substantiated the diagnosis. Subsequent X.12 encapsulation and parsing of the images at LLNL indicated the X.12 encoding-decoding process was not introducing the anomalies.

However, large image files frequently required retransmission (SM-ALC to LLNL) before a complete file was successfully captured. The image anomalies introduced were very consistent . An anomalous image would always start correctly, but subsequently become truncated or fatally flawed. The indications were that large files, such as the X.12-encapsulated image sets, were vulnerable to individual node time-outs enroute to the LLNL destination.

## 5.3    Procedural Anomalies

The CALS image data transferred between LLNL and SM-ALC lacked some of the more fundamental procedural aspects of an ideal CALS data interchange. Most of these issues were due to the lack of experience in implementing CALS data exchanges.

The CALS digital data interchange strategy embodies both file format requirements and procedural data requirements. The procedural aspect is embodied in Declaration files which act as the logical equivalent to the rubber-band (and paper documents) that holds a set of microfilm aperture cards together. Additionally, each image file contains a header consisting of American Standards Code for Information Interchange (ASCII) text that provides the logical equivalent of the information normally written or punched on a microfilm aperture card.

The equivalent images on an aperture card have a tangibility that provides an advantage to a user. These cards are easily recognizable by their color, corner cuts, additional information written or punched into them, their physical location, or their attachment to other documentation. A logical equivalent to most of these issues can be developed in the digital environment, but must be explicitly accomplished and adhered to by the users.

Each image file has an ASCII header that allows for the identification of the image at both the source and the destination. In addition, a "notes" field is supplied to allow extra identification. The CALS file naming conventions were designed to provide a logical relationship between files. The CALS Declaration files are intended to provide a logical relationship between CALS file sets.

The CALS data retrieved from the SM-ALC EDCARS system arrived at LLNL without Declaration files, without any substantive image file header identification, and absent of CALS file naming conventions. In addition, the image orientation parameter in almost all the image files from both sets of data was incorrect, having been presented as 090,270 when in fact most of the images were correctly oriented using the values 000,270.

Conversely, the CCITT Group-4 binary image encodings, the pel-path, and line-progression parameters were all correct, allowing the images to be successfully decompressed and displayed at LLNL. Part of the CALS/EDI development process should be the definition of operational requirements which will properly implement the procedural attributes of CALS data being interchanged.

## 5.4   Summary

The two CALS data sets were converted to X.12-841 transactions at LLNL, transferred to TRW via an X.400 backbone, and decoded as CALS data by TRW. The CALS files, which were returned to LLNL for analysis indicated that all the binary data survived the network transfer and the AT&T VAN without anomaly.

The processing of this data, as a function of being transferred by an EDI transaction, did not alter the original images.

# 6 Conclusions and Recommendations

The CALS/EDI transfer test demonstrated the ability of an end-to-end technical data interchange using an X.12-841 binary data transaction supported by a single VAN using an X.400 routing system.

The data used for the interchange was technical data generated by the engineering data repository (EDCARS) at SM-ALC and provided to LLNL by the SM-ALC procurement system as actual requisition data.

LLNL received the data over the Internet/DDN, in preparation for acting as the source node in a CALS/EDI transaction. TRW would act as the destination node.

The gateway hookups on the Internet, from SM-ALC, proved to be unreliable both in allowing access to the SM-ALC AT&T/3B2 computer and in handling large files. Several paths were used to move files between LLNL and SM-ALC. All access was via Internet/DDN using the TCP/IP protocol. No paths were found to be optimum.

The CTN recommends that SM-ALC reevaluate their network topology to optimize the gateway activity and accommodate more robust digital data applications.

Testing indicates that network requirements for light usage, such as E-mail, are easily supported by any number of ad-hoc network configurations, implemented in a random topology. However, as the requirements for more substantive network traffic are imposed, it becomes apparent that, in general, DoD (and commercial) network implementations will have to undergo more formal planning and implementation mechanisms.

The end-users implemented commercially available PC based platforms and software to accomplish the connection. In this test the data was routed through one VAN, an AT&T X.400 data hub. Given the interoperability specified by the standards, future tests should be targeted at processing CALS/EDI traffic through multiple routing hubs to demonstrate the potential topological flexibility of the technology being applied.

The test succeeded in demonstrating the end-to-end transfer of technical and business data in a digital environment using national standard protocols and commercially available hardware, software, and services.

## APPENDIX A

### Acronyms

| | |
|---|---|
| ANSI | American National Standards Institute |
| ASCII | American Standard Code for Information Interchange |
| AT&T | American Telephone and Telegraph |
| BIN | Binary |
| CALS | Computer-aided and Acquisition Logistic Support |
| CCITT | Comite Consultatif Internationale de Telegraphique et Telephonique, or International Consultative Committee on Telegraphy and Telephony |
| CSRC | CAM Software Research Center |
| CTN | CALS Test Network |
| DDN | Digital Data Network |
| DEC | Digital Equipment Corporation |
| DoD | Department of Defense |
| DSREDS | Digital Storage and Retrieval Engineering Data System |
| EC | Electronic Commerce |
| EC/EDI | Electronic Commerce through Electronic Data Interchange |
| EDCARS | Engineering Data Computer-Assisted Retrieval System |
| EDI | Electronic Data Interchange |
| EDMICS | Engineering Data Management Information and Control System |
| FTP | File Transfer Protocol |
| GMS | Global Messaging Service |
| ISDN | Integrated Services Digital Network |
| LAN | Local Area Network |
| LLNL | Lawrence Livermore National Laboratory |
| PCIP | Procurement, Contracting and Industrial Preparedness |
| QSTR | Quick Short Test Report |
| SGML | Standard Generalized Mark-up Language |
| SM-ALC | Sacramento Air Logistics Center |
| TCP/IP | Transfer Connection Protocol/Interchange Protocol |
| VAN | Value Added Network |
| WPAFB | Wright-Patterson Air Force Base |

### Standards

MIL-STD-1840A
MIL-R-28002A
X.12
X.400
X3.27

A-1